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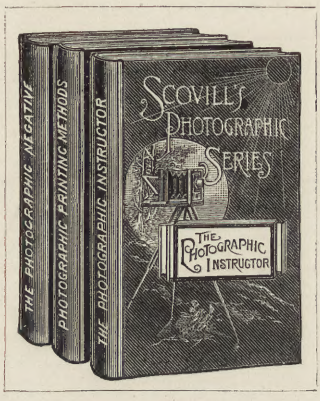

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INDUSTRIAL PHOTOGRAPHY

BEING A

DESCRIPTION OF THE VARIOUS PROCESSES OF PRODUCING INDESTRUCTIBLE PHOTOGRAPHIC IMAGES ON GLASS, PORCELAIN, METAL AND MANY OTHER SUBSTANCES.

ILLUSTRATED.

By P. C. DUCHOCHOIS,

AUTHOR OF

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"The Lighting in the Photographic Studios," Etc., Etc.

NEW YORK:

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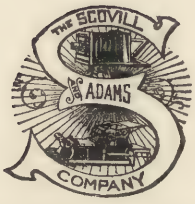

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PREFACE.

PRINCIPALLY in response to numerous requests, and also owing to the undoubted interest taken in these articles as they originally appeared in *The Photographic Times*, the publishers have been induced to reprint them in a handier and more permanent form. They have also been somewhat improved.

INDUSTRIAL PHOTOGRAPHY.

It may be said that there is no industry to which the processes of photography are not applied. Lithography, engraving and typography have, by their means, been enriched with comparatively costless and rapid mechanical processes for the reproduction of drawings, oil paintings, portraits and views taken from nature which hitherto required the talent of trained artists, much time and expense. The ornaments of cabinets, mantel-pieces, etc., are now made with engraved plates; tiles and imitations of decorated ivory and wood, from photo-reliefs and photo-intaglios, the latter also serving to produce the *émaux cloisonnés*; and for years engravings and etchings on glass-plates, enamels on metals, painting *en grisaille* or in colors on window glass, porcelain, pottery, etc., have been produced by processes requiring but little practice to arrive at success.

We have recently described in *The Photographic Times* the various photo-engraving methods in relief, in line-intaglio and in aqua-

tint. We now propose to initiate the reader into the other industrial applications of photography, by the description of the most practical methods of enameling porcelain, potteries, glass and metals, and to incrustate enamel on precious metals, on glass and metallic plates, and kindred processes.

Photo-Vitrified Enamel Processes.

There are two methods employed to photographically fix the vitrifiable colors on glass or other suitable material, viz., the substitution process invented by Du Motay and Maréchal, and the dusting processes due to A. Poitevin or the outcome of his inventions.

Substitution Process.

The substitution process is very simple and yields as good if not sharper and finer pictures than the dusting process. It is, however, to our knowledge, little employed in the arts, probably on account of the necessity of making a cliché for each proof, which complicates the process. As to the cost of the materials, it is not so great as to be an objection. The process consists in making an ordinary silver positive photograph on a glass plate, and then to transform the metallic silver, which forms the image, into gold, platinum, iridium, or an alloy of these

metals, and to burn it in on porcelain, enameled copper plates, etc., when a picture colored by the tint imparted by the noble metals in question is indelibly fixed.

The photograph is, of course, a diapositive. It cannot be made on gelatine film, not only on account of the great quantity of carbonaceous matters the gelatine contains, but also because, in fixing, the film shrinks and thus prevents the adhesion of the vitrifiable substances to the support. The collodion process, wet or dry, should be employed, the former preferably. A glass plate, perfectly cleaned, is rubbed dry with a little alcoholic ether tinted to a brandy color with tincture of iodine—no substratum, no talcing should be made—then edged with an india-rubber solution* and then coated with bromo-iodized collodion, and, when the film is set, coated once more in the opposite direction, which is important, to obtain a film of the same thickness throughout. It is then sensitized, exposed, and developed with ferrous sulphate, strengthened with pyrogallol and silver nitrate, and again, if necessary, after fixing in a *new* and weak solution of potassium cyanide.

When viewed by transmitted light the details

* This is necessary to hold the film during the subsequent operations if the collodion is of the contractile kind, otherwise it might be dispensed with, which is preferable.

should be well defined, the deep shadows black, and the very high lights represented by the clear glass. The general intensity should be regulated according to the object in view, since the image when burnt-in will present the same opacity, or nearly so. If the picture is to be burnt-in on glass plates, and, therefore, viewed as transparency, the intensity must be greater than when burnt-in on an opaque material, in order to obtain vigor and brilliancy. Two or three trials should be made to judge how far the intensification should be carried on. No rule can be given,—the reason is obvious. We need hardly say that the diapositive should be perfect.

We recommend the following collodion as yielding an intense reduction by ordinary development, and without fogging the whites (clear glass) of the picture, which is a *sine qua non.*

Ether	250	c. c. m.
Alcohol	250	c. c. m.
Sodium iodide	3	grams
Cadmium iodide	1.5	gram
Zinc iodide	0.5	gram
Ammonium chloride	0.15	gram
Zinc bromide	1	gram
Pyroxiline	5	grams

Dissolve the iodides, bromide and chloride in alcohol, filter, then add the pyroxiline, and lastly the ether by small quantities, shaking after each addition. Let settle for at least forty-

eight hours. The pyroxiline should not be of the powdery kind; this is important. The silver bath, 9 : 100, must be pretty well acidified and in excellent order, and the iron developer compounded with 2 per cent. of glucose; thus:

Ferrous sulphate	25 grams
Glucose	10 grams
Tartaric acid	2 grams
Water	500 c. c. m.
Acetic acid, No. 8	15 c. c. m.
Alcohol	quantum suff.

We have already said that the diapositive should be perfect. For that purpose, and in order to avoid pinholes, black spots and surface markings (superficial metallic reductions) which are the most teasing defects occurrent in the wet collodion process, we strongly advise the operator to immerse the sensitized plate for two or three minutes in the following special silver solution, and on removal from the same, to place it, before exposing, on several folds of blotting paper until the superfluous liquid is absorbed. Thus prepared, the sensitive collodion film will keep moist for a long time.

Silver nitrate	20 grams
Gum arabic	25 grams
Glycerine, C. P.	150 c. c. m
Acetic acid, glacial C. P.	2 c. c. m.
Water	500 c. c. m.

After intensifying for the second time it is

well to dip the plate twice in and out in the fixing solution, then to wash it thoroughly under the tap, and this done the picture is ready for the toning or substitution process. There are different methods of operating. "We immerse the plate for a certain period," say Messrs. Du Motay and Maréchal, who had in view the application of their process to the staining of glass plates, "either in a bath of chloride of gold and platinum, or in alternate baths of gold and platinum, or again in chloride of gold. During this treatment the silver forming the image is partly replaced either by platinum or by a mixture of gold and platinum.

"The object of these different baths in which we form the layer of metallic silver is to either vary the color or the nature of the image after it is vitrified. If one wants to obtain a greenish-black color by the action of the siliceous or boracic flux in the muffle, we first immerse the image in a chloride of platinum solution; if, on the contrary, we desire to produce a black image, the proof is treated alternately with a bath of chloride of gold and one of platinum. When a gilt image is required we employ the chloride of gold only.*

"On its removal from the gold or platinum

* The reduction to metallic state depends on the temperature at which the plate is fixed.

bath, the proof is washed in a solution of alkaline cyanide, or in concentrated aqueous ammonia, then rinsed, and when dry covered with a varnish of caoutchouc or of gutta percha and placed in the muffle to burn the organic matter and obtain a metallic image, free from foreign matter. Lastly, the image is covered with a boracic or silicic flux and exposed to the action of an orange-red heat to vitrify it." *

The present process is not exactly as directed by the inventors; other metallic salts are employed to obtain certain colorations and the *modus operandi* differs somewhat. In the following we give the formulas. The solutions may be used more concentrated, but there is no advantage of so doing; moreover, by employing dilute baths the chemical changes are more regular, better under control, and the delicate details well preserved.

The toning or substitution baths should be acid *but contain no free hydrochloric acid.* The gold and platinum solution is prepared in the following manner:

Platinic chloride	1	gram
Auric chloride	0.5	gram
Water	500	c. c. m.

Neutralize the solution with sodium bicarbonate—the solution must turn red litmus paper

* Bull. Soc. Franc. Photo., 1865.

blue—then add, drop by drop, pure nitric acid until the test paper just turns red. The proofs treated by this solution are of a fine rich purple-brown when vitrified.

The toning bath of platinum consists of

Platinic chloride	1 gram
Water	500 c. c. m.

Neutralize as directed above. The burnt-in image is black in the shadows with very fine grays in the half tints.

IRIDIUM BATH.

Saturated solution of potassic iridium chloride	10 c. c. m.
Water	100 c. c. m.

The bath of gold and iridium employed by Mr. Watson consists of

Saturated solution of potassic iridium chloride	50 c. c. m.
Water	360 c. c. m.

to which is gradually added, shaking after each addition,

Solution of chloride of gold, 1 : 60. 25 c. c. m.

Gold, platinum and iridium bath :

Platinic chloride	2 grams
Iridic chloride	1 gram
Auric chloride	0.5 gram
Water	1000 c. c. m.

All these solutions keep well and can be used over again. Iridium is employed to darken the

tint. Palladium gives a black less intense; when added to the platinum and gold bath in very small quantities it tends to produce a purple color. With platinum only, the proof is sepia. The following is a good formula:

Platinic chloride	2 grams
Palladious chloride	0.5 gram
Auric cloride	0.2 gram
Water	1000 c. c. m.

The next bath gives a black image. After toning and washing the film should be immersed in a solution of concentrated aqueous ammonia diluted with one-tenth its volume of water:

Mercuric chloride	1 gram
Auric chloride	0.5 gram
Water	200 c. c. m.

When, after treatment by any one of the foregoing toning solutions, the image requires to be cleared or a warmer tone desirable, the proof is treated by an uranium bath consisting of

a Potassium ferricyanide	1 gram
Water	300 c. c. m.
b Uranium nitrate	1 gram
Water	300 c. c. m.

For use, mix equal volumes and add 2 or 3 drops of a solution of auric chloride at 1:100.

The proof should remain but a short time in the uranium bath, as the image is rapidly

reduced in intensity. The color in firing tends to a brown or sepia, the tint varying with the toning treatment first employed.

When the proof is to be burnt in on the glass plate upon which it is made, it may be treated, before toning, by mercuric chloride, until the image is uniformly black by reflected light.

Mercuric chloride	12 grams
Hydrochloric acid, pure	1 c. c. m.
Water	500 c. c. m.

This is done in a moment; therefore, one should watch the action attentively, as the image should not be allowed to bleach.

For transferring upon porcelain, enameled copper plates, pottery, etc., the film must be detached from the support before any treatment whatever, except, of course, the intensification and fixing, but not the amalgamation which, when resorted to, is done after detaching the film. To detach it the plate is immersed in water acidified with, say, 5 parts of sulphuric acid per cent. This acid causes a contraction of the collodion film which thus loosens its adherence to the plate and may be detached by gently agitating the liquid or lifting the edges. If any difficulty be experienced a solution of hydrofluoric acid at 1½ or 2 per cent. of water may be substituted for that of sulphuric acid.

As soon as detached, the film is washed, image

upward, in water several times renewed by decantation, and when all traces of acid are eliminated, the toning bath selected is poured into the tray.

The image should be toned through in the deep shadows to obtain an uniform coloration of the whole image when it is burnt-in. The time required to effect this necessarily varies with the opacity of the silver reduction and the strength of the toning baths. But the image cannot be overtoned, or very little, for when all the metallic silver is converted into silver chloride the chemical changes are at an end. The following equation explains it :

$$AuCl_3 + Ag_3 = 3AgCl + Au.*$$

After toning, the proof is washed by decantation, then immersed for, say, half a minute in concentrated aqueous ammonia diluted with a hundred volumes of water, then washed and finally transferred *collodion side downward* to the selected material. For that purpose no organic adhesive substance should be employed, but simply a saturated aqueous solution of fused borax.

When dry the picture is gradually heated to

* This equation does not exactly represent the chemical action, for a certain quantity of metallic silver unites to the gold set free. If the substitution bath consists of platinum and gold, the image will consequently be formed of an alloy of silver, gold and platinum in various proportions.

a full red cherry heat, then removed from the muffle, allowed to cool very slowly and finally glazed. This, in our hands, has been found an excellent method. Some operators advise application of the flux (glazing) before firing, which is best done by dusting. Another method recommended by Mr. Thomas Bolas is thus described by himself: "So much of the flux as will lie on a florin is rubbed up in a mortar with fifteen c. c. m. of spirits of wine and then shaken up with the same quantity of non-iodized collodion. After the collodion film has burnt off in the furnace, the picture is allowed to get cold, then the mixture of flux and collodion is flowed over it, and afterward drained off, and the last drops removed with a piece of blotting paper, for if they were allowed to remain they would cause a light colored spot."

It seldom occurs that the glazing is brilliant enough after the first firing, hence the operation should be repeated once or twice over. More perfect pictures are obtained by thus proceeding gradually, and if defects appear they may be corrected before the last glazing is done.

The burning-in, glazing and other operations mentioned in the foregoing will be described further on *in extenso*.

Dusting Methods.

The dusting method consists in coating a plate with a compound which becomes hygroscopic under the influence of light or loses its property of absorbing moisture by the same reducing action, whereby any substance ground into powder adheres to the parts only which become or remain hygroscopic.

The compounds which light renders hygroscopic are prepared with ferric chloride; a negative is consequently employed in printing on them, while those which are deprived of the property in question are rendered sensitive to light by an alkaline chromic salt, and require to be exposed under a diapositive. All these compounds we will call "Photogenes."

Ferric Chloride Dusting Process.

The ferric chloride photogene is prepared according to this formula:

a Ferric chloride crystallized..... 25 grams
Water.....100 cub. cents.

b Tartaric acid..... 12 grams
Water.....100 cub. cents.

Filter both solutions. For use mix equal volumes. Tartaric acid is the sensitizer, there-

fore when mixed with the iron salt the solution should be kept in the dark.

By increasing the proportion of tartaric acid more vigor or contrast is obtained. It is not advisable to diminish the percentage given in the above formula unless the cliché be much too intense, else the picture would be flat and the pure whites more or less tinted. A small quantity both of glucose and dextrine may be added to the photogene. It causes a more rapid reduction of the ferric chloride, imparts more brilliancy to the image, and renders the process more manageable in cold and damp weather.

Mr. Gobert advises the preparation of the photogene in the following manner, stating that the ferric chloride of commerce is seldom sufficiently pure for this and other photographic processes in which it is employed: A certain quantity of ferrous sulphate in concentrated solution is first treated by nitric acid in excess, which transforms it into ferric sulphate. This salt is then precipitated by aqueous ammonia and the precipitate—ferric oxide—washed by decantation, is dried and kept for use. To prepare the photogene nine grams of oxide is dissolved in hydrochloric acid C. P. *not in excess*, then water is added to make up one hundred cubic centimeters, and after dissolving nine grams

of tartaric acid and filtering, the solution is ready for use.*

The following photogene devised by the late J. B. Obernetter to obtain diapositives also gives excellent results:

Iron citrate	10	grams
Citric acid	0.5	gram
Conc. sol. ferric chloride	2	c. c. m.
Water	100	c. c. m.

"The citrate is pulverized very fine, and the three ingredients are put in a beaker and the water added. The water is then heated to boiling point, stirring continually until the citrate is dissolved and the solution, when settled and cool, filtered through paper."

All these photogenes should be kept in the dark. They do not keep more than two or three days in very good condition. It is best, however, to prepare them the day before they are wanted for use.

To prepare the sensitive film, a plate of glass ground very fine, such as those employed as a focusing screen in the camera, is soaked in a solution of potassa, rinsed, immersed for an hour or more in nitric acid, rinsed again, dried, dusted and coated with the photogene.

In this as in every other dusting process it is

* We never had any difficulty with the ferric chloride C. P. obtained from Eimer & Amend.

of the greatest importance, in order to avoid white and black spots in the finished picture, to operate in a room free from dust floating in the air, which during the operations are deposited on the plate. For this purpose the room—which, if possible, should be small and have no shelving—must be swept, then sprinkled with plenty of water, say, an hour before coating or developing, and the floor kept damp during these operations. Any draft of air should, of course, be prevented. For the same reason the photogene should be carefully filtered, allowed to stand for a certain period, then decanted for use.

The plate should be coated twice, the second time in the opposite direction, drained on the filter, then placed at an angle upon blotting paper and allowed to dry spontaneously in a drying box in which is kept a tray containing concentrated sulphuric acid, or quick-lime, or, better, desiccated and powdered calcium chloride, manufactured for such and other purposes and sold for a few cents per pound.

This method of operating is good, but the writer prefers to coat the plate, ground or not, by means of the turning table revolved at a moderate speed, and to dry it held horizontally over a spirit lamp or in an oven, the coating being more even and the plate prepared in a

few minutes just before exposing.* When dry the film should be even and bright. If it appears whitish and dull, it indicates a bad preparation.

The plate is exposed under a negative, neither very intense, nor too soft. A black cloth should be laid over the plate while printing. If it is not exactly of the right quality, a good impression may be obtained by increasing or diminishing the dose of tartaric acid, as before pointed out, or by having recourse to the printing dodges employed in silver printing.

In sunshine the exposure varies from 4 to 6 minutes. In the shade it is about four times longer. No rule can be given to determine it *a priori*; it is only acquired by experience, and since the progress of the light action cannot be followed by viewing the plate from time to time as in the printing paper process, we advise the beginner to use a photometer to regulate the time of exposure.

On the removal of the plate from the printing frame the image is faintly visible on the yellow ground of the film which now absorbs the

* Drying in an oven is the most practical method when working on a small scale, by this or other dusting processes, for the number of plates required for a day's use can be prepared at once and kept quite dry and warm for exposure, which is a condition of success.

There is sold on the market, for cooking purposes, a tin oven, about one foot square, heated over a petroleum stove, which is a convenient article for the purpose.

atmospheric moisture in the parts altered by light in proportion to the degree of this alteration, or more properly speaking, in proportion to the more or less complete reduction into ferrous chloride of the ferric salt constituting the sensitive film. Consequently when after allowing the film for a short period to attract water, which depends on the hygroscopic state of the air, the enamel powder is applied to the plate with a camel's-hair brush, it will adhere to those parts in proportion to the amount of moisture absorbed and the image appear with its gradation from light to shade. Generally the half tints do not make their appearance simultaneously with the shadows, which is rational and usually indicates a correct exposure, for the moisture is necessarily attracted so much more rapidly as the reduction of the ferric compound is more complete. Consequently, one should proceed by successive applications of the enamel powder, allowing the film between each one to attract more moisture, in order to facilitate the adherence of the powder, and to breathe upon those parts which develop too slowly or do not intensify sufficiently.

The development is effected by placing the plate upon a white cardboard, but the effect should be judged by viewing the picture by transmitted light, moreover by reflection it

always appears stronger than it should be for burning-in.

If it happens that by excess of exposure the image becomes impasted and the whites (high lights) tinged, "it is easy to remedy, in part at least, by dusting upon the plate (previously well desiccated by heat) some finely pulverized glass, and rubbing with a tuft of cotton-wool; the particles of glass remove the enamel powder which fogs the image, and the design becomes clear."

The image being perfectly developed, the non-adherent powder is dusted off and the plate coated with plain collodion.

Ether concentrated	60 c. c. m.
Alcohol 95 deg	40 c. c. m.
Castor oil	3 drops
Pyroxiline	1½ to 2 grams

As soon as the film is set, the plate is immersed in a 3 or 4 per cent. aqueous solution of hydrochloric acid, which renders soluble the iron salt and destroys the adherence of the collodion film to the plate. This done the plate is washed under the tap, immersed in a tray filled with filtered water where the film can be easily removed from the plate, and when the last traces of acid have been eliminated transferred collodion side downward upon the material upon which the image is to be burnt in. The method of transferring will be explained further

on. We must say, however, that as an adhesive medium nothing but a saturated solution of borax should be employed.

The Bichromate Dusting Process.

PHOTOGENES.

1. M. L. de Lucy-Fossarieu's Formula.

Prepare the following stock solutions :

a Saturated solution of borax in water.....1000 c. c. m.

One obtains a saturated solution by adding to hot water as much of a salt as can be dissolved, allowing the solution to cool twenty-four hours and decanting for use.

b White sugar..... 200 grams
Gum arabic..... 60 grams
Water.....1000 c. c. m.

Agitate from time to time until the gum is dissolved, then add 500 c. c. m. of the borax solution filtered before mixing. This solution improves by keeping.

c Honey, the best.....20 grams
Borax solution, filtered.....20 c. c. m.

This solution keeps well

d Saturated solution of ammonium bichromate..100 c. c. m.

Sensitive mixture.

Boracic solution A..... 6 c. c. m.
Bichromate solution D..... 4 c. c. m.
Water.....10 c. c. m.

If the weather is very hot and very dry add three or four drops of the boracic honey C

2. Mr. Geymet's Formula.

Glucose, liquid	5 grams
Gum arabic	5 grams
Honey	0.5 gram
Sat. sol. ammonium bichromate	20 c. c. m.
Water	100 c. c. m.

3. The Author's Formula.

Dextrine	3.5 grams
Glucose, liquid	3.5 grams
Ammonium bichromate	2.5 grams
Glycerine	2 drops
Water	80 c. c. m.

In dry weather the proportion of glucose can be somewhat increased.

4. Another.

Gum arabic	10 grams
White sugar	10 grams
Ammonium bicromate	4 grams
Water	100 c. c. m.

All these formulas are reliable and yield proofs of great beauty. That of Mr. L. de Lucy-Fossarieu—a great authority in this process—consisting of stock solutions which keep and can be mixed in a minute to prepare the sensitive liquid, is certainly the most convenient.

The photogenes should be prepared and kept in the dark-room. It is best to make them a few hours beforehand. They must be filtered twice, allowed to settle, then when wanted for use, decanted with care to avoid air bubbles.

The plate of glass which will serve as a temporary support having been cleaned and dusted is heated slightly, and the photogene flowed over, or spread in an even and thin coating by means of the turning table, then dried in the latter case in a horizontal position in the oven, or by means of an alcohol lamp. The heat must always be endurable to the hand (about 55 deg. —60 deg. C.) else the film would be *burnt*, the transfer impossible, or effected with difficulty, the film in places strongly adhering to the support.

An excellent manner of drying, when the plate is coated by hand, is the following, which was devised by M. de Lucy-Fossarieu. When the superfluous liquor has run out in the filter, the plate is placed resting on one angle upon blotting paper for two minutes and dried in the same position. For that purpose it is laid on an iron plate set up on unequal legs, two of fifteen centimeters and the two others of twenty centimeters, in such a manner that the plate presents a certain incline, and heated underneath with an alcohol or a night lamp. In order that the heat be equally distributed the iron plate should be lined with two or three thicknesses of blotting paper. It is important that the photogene dries pretty rapidly for the bichromate in the quantity employed may crystallize

if the film be allowed to dry spontaneously, or too slowly.

When quite dry the film should have an even and brilliant appearance. It does not keep. Hence no more than, say, half a dozen plates should be prepared beforehand, and they must be kept in a desiccating box on account of the hygroscopic nature of the preparation.

It is useless to repeat that all these operations should be done sheltered from dust and in semi-obscurity, and that the clichés must be diapositive, very clear, soft, and quite sharp. It is well to make them without redeveloping or intensifying.

The time of exposure varies from 30 to 40 seconds in sunshine, and from 4 to 10 minutes in the shade. In dark, overcast weather it is so lengthened that it is better not to operate, unless one is provided with electric light. In this case two or three minutes suffice to impress the photogene. By daylight we advise exposing in the shade, for, generally, the proofs obtained by direct exposure to the sun are hard, that is, present too great a contrast of light and shadows.

In this process the reduction of the bichromate deprives of their hygroscopic property, the substances entering into the composition of the photogene, from which it results that under-

exposure causes the powder to adhere too readily all over, the image coming out heavy, with fogged whites like an over-printed silver proof. Over-exposure necessarily produces the opposite defects, the proof being harsh, without half-tints, but if not exaggerated it is beneficial.

After exposure the image is visible faintly, if the exposure be right. When it is well defined it is a sure sign that the exposure has been too long.

On its removal from the printing frame the plate should be heated if the weather be damp, then allowed to cool and to absorb moisture for a period varying with the hydroscopic state of the air before commencing to develop. There is nothing absolute in this; practice alone makes perfect.

The dusting-on is done with a camel's-hair brush, by dabbing very lightly at first to spread the powder all over the film, then describing small circles without pressure. But seldom, if ever, the image appears with all its gradations from light to shade on the first application of the powder, and it is well that it be so, for it usually indicates that the plate has been rightly exposed, since the image is formed by the various degrees of hygroscopicity of the film, the parts the most impressed—the whites of the

picture—not attracting moisture as rapidly as those which have been little or not at all acted on, which retain their primitive hygroscopic property, and, therefore, the quantity of adhering powder being proportionate to these different states of hygroscopicity. Hence the dusting on should be repeated at intervals of from five to ten minutes, in order to allow the absorbtion of more moisture on the parts which attract it less rapidly, which in the meantime permits the exposure of another plate if the first one is thought not well exposed, or to develop several plates in succession.

It may happen that the absorption of moisture is too rapid. Such is the case when the exposure is short or the weather very damp ; then the film being tacky, the camel's-hair brush drags and the powder adheres in a mass. As soon as this occurs the powder should be shaken off, the plate dried over the alcohol lamp, then allowed but for a very short period to again absorb moisture before proceeding anew. On the other hand, if the weather be very dry, the delicate half-tints may hang back and the picture not acquire sufficient vigor, although the exposure may be correct. Then, *but then only*, which is of a very rare occurrence, it is well to breathe on the parts to be brought out or strengthened, with a small glass tube, then to allow it to evaporate

the moisture from the white, that is, the non-hygroscopic parts, before applying the powder.

To resume : the image must appear gradually as the film absorbs the moisture of the room. The parts first developed are necessarily the darkest—the deep shadows, the hair, the dress, in a portrait. It is well that on the first application of the powder the whole image does not appear, for, otherwise, the exposure would be too short and the image would become heavy. Such proof should be set aside at once; it will never yield a good enamel. If, on the contrary, the image hangs back, if after, say, five applications of the powder it remains stationary, the proof is over-exposed and should also be rejected, although it might be possible to bring it out by breathing, but after burning-in the picture will be flat and gray, without vigor. Only perfect proofs, without blemish, should be fired, for any defect in the enamel necessitates much working up and loss of time, while there is little trouble and expense in preparing, exposing, and developing another plate. For this reason, it is advisable to make two or three proofs from the same negative, in order to select the best for firing.

Here is another method of developing, often employed by M. de Lucy-Foissarieu and by him particularly recommended : "It is to throw a

great quantity of enamel powder on the proof and to shake it every way. By this operation, the weight of the powder replaces the pressure of the brush; its action is even more regular, softer, and furthermore the finest particles of the powder are generally in immediate contact with the image. I use the brush only to commence and finish the development."

One must bear in mind that in the dusting processes moisture is the most important factor, and that, aside from those originated by errors in the time of exposure, most of the failures arise from not paying enough attention to the state of the weather, *i. e.*, the dampness of the air. As before observed, whenever the development proceeds rapidly, which is ascertained by the first application of the powder, the film should be dried before proceeding, and the heating repeated if necessary after each dusting on, and allowing the film to absorb more and more moisture to finally bring out the faintest details. The brushes—several should be at hand—must of course be quite dry, and also the powder, and the saucer which contains the latter should be covered to shelter the enamel from dust; any foreign substance interposed between the plate and the enamel cause white spots when the picture is burnt-in.

When the image is well developed, which is

ascertained by viewing it by transmitted light —and indeed many operators develop by holding the plate to the light—the superfluous powder is dusted off with a broad camel's hair brush, rubbing from top to bottom, then crossways. If it appears heavily impasted, the plate should be heated to insure complete desiccation, then the powder in excess removed with a tuft of cotton wool, or, for local alterations, with a brush exerting pressure. If the plate has been somewhat under-exposed, the picture can be thus improved, but, if the image is harsh, devoid of the delicate half tints from over-exposure, there is no remedy, for, when the development has been forced by breathing upon the film, the powder will fall from the parts upon which it is apparently fixed, because these parts having lost their hygroscopic property, the moisture imparted by breathing upon them is superficial, not absorbed, and consequently incapable of retaining the powder.

The image should be developed until more intense, when to be viewed as a transparency, than when to be fixed on an opaque material. In the latter case it should be weak by transmitted light; when burnt-in it will always be dark enough, especially if it has to be colored. It should, however, be developed a little darker and the whites or high lights slightly tinted in

order that the half-lights be well defined, for by firing the picture always loses its intensity. It must also be observed that the image to be burnt-in on delf or on porcelain should be lighter than for enameled copper plates. All this does not present any great difficulty, but requires, however, some experience. No instruction can be given.

Transferring.

The image can be burnt-in on the plate upon which it is developed, or transferred to the material selected to receive it. In the first case the operation is quite simple: The plate is coated with photogene No. 3, dried and exposed under a reversed (stripped) diapositive. In sunshine a few minutes suffices. It is well to cover the printing frame with tissue paper; the exposure is a little longer but the image comes out with softer gradations. After development the proof is fixed by dipping the plate *without* stopping in an alcoholic solution of borax which hardens the film, dissolves the chromium compound and eliminates all traces of bichromate. This done the plate is rinsed with a similar borax solution, allowed to dry spontaneously when it is ready for the muffle.

Borax fused	30 grains
Water	250 cub. cents
Alcohol 95 deg	1,000 " "

Dissolve the borax, pulverized, in water by the aid of heat, add the alcohol and filter when cold. Keep each of the washing solutions separately ; they can be used over again.

In transferring, the plate is heated after development, then allowed to cool and immediately coated with the plain collodion. the formula of which has been given in the description of the ferric-chloride process. As soon as the film is set, the plate is immersed in a dilute solution of potassa to decompose the chromium compound which otherwise would impart an unpleasant greenish tint to the enamel :

Potassa	20 grams
Water	1,000 cub. cents

On the removal from this, the plate, after rinsing under the tap, is placed in water acidified with 5 or 6 parts per cent. of hydrochloric acid, and as soon as the collodion film loses its adherence to the plate, which is ascertained by lifting up the corners, the plate is transferred to a tray of water, when the film being detached along the edges leaves hold of the plate and should then be rinsed in several changes of water filtered before use.

It may happen that the proof strongly adheres to the plate and, in consequence, the collodion film cannot be detached. This arises from the photogene having been dried at too high a

temperature, or from the plate being prepared a long time before use. In such an emergency the proof may be saved by substituting for the hydrochloric acid a 12 per cent. aqueous solution of hydrofluoric acid.

The film may be transferred image upward or downward. In the latter case when the stripped film is well washed, the water is poured off and replaced by the following adhesive solution.

Seed of quince	5 grains
Sat. sol. of borax	100 cub. cents
Water	1,000 " "

Allow it to dissolve for five or ten minutes, and filter.

This done, the film is turned over with a broad and flat brush so that the image is downward, and the plate—enameled copper, glass, porcelain, etc.—cleaned beforehand by rubbing with whiting wetted with a weak solution of soda, then rinsed, dried and well dusted, is introduced underneath the film and the latter placed upon it under the water. Now, by lifting it with a convenient tool, the plate is removed from the liquid with the film adhering to it and kept at the very edge with the fingers or a flat brush, then, after having adjusted the picture to the proper position and stretched it without any crease, the film overhanging is turned round to

the back of the plate and on the whole is laid a sheet of blotting paper and over this another of ordinary smooth paper. This done, with a tuft of cotton or of any soft material, one gently dabs all over the plate, to sponge off the water and secure everywhere a perfect contact of the image and collodion film on the plate, else the proof will split out or scale in the subsequent operations. Finally the blotting paper is replaced by several folds of the same, the plate placed under a slight pressure, and when the superfluous moisture is absorbed—which requires from fifteen to twenty minutes—the film is allowed to dry spontaneously. If blisters are formed during the desiccation, which occurs solely by want of care, they should be burst before drying, with the point of a needle, and the liquid sponged off.

Before firing, the proofs transferred by this method, the collodion film should be destroyed. For that purpose, the plate is placed on a glass dipper and lowered in a vertical glass bath filled with concentrated sulphuric acid. In a short time—about ten minutes—the collodion is destroyed, together with the organic substances of the photo-film, which is shown by a red brown coloration around the image. Then the plate should be slowly taken out from the acid bath, and placed in a tray of filtered water.

The water must of course be renewe several times to wash out the acid, but this should be done by decantation and with extreme care, for the picture not now being held by the collodion film, the least contact, the least abrupt undulation of the liquid may injure it past remedy. Lastly, the plate is drained, then dried on the iron plate lined with blotting paper and heated with a spirit lamp. It is now ready for the muffle.

The collodion can also be dissolved by the following solution :

Oil of lavender	100	c. c. m.
Oil of turpentine	3	"
Ether	50	"
Alcohol	50	"

But as the plate must remain in the solution from eighteen to twenty hours, then rinsed with a mixture of alcohol and ether, the former method is more practical and just as safe if the proper precautions be taken.

Another method devised by the writer which does not necessitate the destroyal or dissolution of the collodion film is the following : When the image is transferred and the collodion film dry, brush it over with a thin coating of turpentine oil thickened with lithographic varnish, let this evaporate to a certain extent and when still tacky dust on a glazing flux, let dry, dust off

the excess of powder and the plate is ready for firing.

The proofs can also be transferred by a method not requiring the use of collodion. It is due to M. Jeanrenaud. In 250 c. c. m. of concentrated ether 25 grams of pure India-rubber are dissolved, cut in very small pieces, and when it is well swelled, which requires ten or twelve hours, 1000 c. c. m. of benzole and 15 grams of rosin are added. When the ingredients are dissolved the solution is filtered and sheets of thin paper are coated with it for use, turning the edges to form a kind of tray, and sustaining the sheets on a wooded board or a glass plate.

For transferring, a piece of this coated paper large enough to cover the whole image is applied to the plate and imbued with a mixture of ether and alcohol in the proportion of 4 to 1 of the latter, then, when the India-rubber is softened, both the paper and the image are pressed into optical contact by means of a squeegee. The whole is afterward immersed for a few minutes in tepid water, the temperature of which is then gradually raised to about 40 degs. C., and the proof, which now adheres to the paper, can be stripped off and transferred to the selected material, after having been previously immersed in an adhesive solution consisting of :

Gum Arabic	10 grams
Water	100 c. c. m.
Glycerine	2 to 3 drops

When the whole is dry, the paper is saturated from the back with benzole, which dissolves the India-rubber, and on being lifted off leaves behind the image adherent to the material. This done, the plate is washed with a little benzole, allowed to dry for a few seconds, then fired as usual. This method is very good for transferring on vases, cups, and on uneven surfaces generally. The following is also effective, but requires more care and working up: Immerse the object in the adhesive solution—the seed of quince mixture—then place the collodion film in the same, then, under the liquid, place the picture face downward to the enclosure made beforehand with a pencil-mark, then withdraw from the liquid the object with the film upon it and stretch the film and make the necessary alterations to place the image in the right position. Now with a soft brush gently dab the film as it dries before a fire so that it fits exactly the curvature of the object, and when dry cut off with a pen-knife the edges of the film projecting outside the enclosure. Do not attempt to destroy the collodion, but heat it with a flux.

The image is generally transferred face upward on surfaces plane or nearly so, or the

curvatures of which can be developed (a cylindrical form, for example). The collodion is therefore in direct contact with the material upon which the picture is to be burnt-in, and as in this position it is held by the flux (borax)* no accident occurs when it is fired, there is no necessity of destroying or dissolving the collodion, which is a great boon, and simplifies the operation. To transfer it, it is only necessary to immerse the stripped proof in a saturated solution of borax and to proceed.

This transferring method or that of Mr. Jeanrenaud should be selected whenever the enamel powder is attacked by sulphuric acid. The enamel colors altered by this and hydrochloric acid are the rose, yellow, green, violet, and generally those prepared with oxide of manganese.

It should be observed that when the proofs are transferred to glass, porcelain or delf, they must be flowed with a saturated solution of borax and allowed to dry before being burnt-in.

If from any cause the transfer had to be postponed until the next day, the proofs should be collodionized, then immersed in water *slightly*

* For further precautions some operators advise the varnishing of the plate when dry with a solution of fat oil of turpentine in the ordinary oil, about 3 per cent.

acidified, for not only the reducing action of the light continues for a certain period in the dark, but by keeping, the whole film becomes insoluble, and adheres so strongly to the plate as to render the transfer impossible. Hence the necessity of not washing out the bichromate entirely, but to dissolve it and keep the proofs damp. As previously said, the water should be acid, no matter how little, in order to prevent the formation on the film of air bubbles, which, in transferring, may interpose themselves between the image and the plate, the result of which is obvious.

Retouching.

However carefully the operations have been conducted there are often in the picture some imperfections which should be corrected before or after firing. Of course, they may arise from those of the negative or the diapositive; and these must be first looked for. Filling the pinholes, removing black stains, strengthening the details not well defined, blending the shadows with the lights, all these methods, together with the usual printing dodges, such as pasting mineral paper on the back of the negative to strengthen the lights or soften the too dark shadows with graphite applied with a stump, and covering the printing frame with tissue

paper when the negative is weak, etc., should be resorted to in order to avoid much retouching on the enamel picture, which is always a delicate operation although not presenting great difficulties, but requiring time and patience.

When the image is developed certain retouchings are best made before transferring. For that purpose the glass plate is placed on the retouching easel employed in photographic establishments to work up the negatives, then the black spots are removed with the point of a needle fixed into a wooden handle, and the white spots filled up with a mixture of the same dusting powder employed for developing ground with lithographic varnish, thinned with turpentine oil and a few drops of sweet oil, and applied with a finely-pointed brush. Lastly, or preferably before this, the shadows may be lightened by rubbing with a sable brush, etc.

After the transfer, if the image is face upward on the support the retouchings are made in the same manner with the same material, but the proof must be previously desiccated by heat—taking care not to burn the collodion—when it is quite resistant and can support a pretty hard rubbing.

The retouching to harmonize the lights with the shadows is necessarily done with the dusting powder, mixed as said above, and applied

by dabbing with a "stippler."* The mixture should be pretty thick in order not to drag, and when filling white spots the flux must not be charged with much color, else black instead of white spots will be the result.

If the proof is transferred face downward the collodion should be first destroyed, the plate washed, dried, then, as before directed, the black spots are removed with the needle point by touching them up perpendicularly, when by blowing off the powder thus detached the effect is ascertained after each stroke. This operation is easily done, and with a little patience one can make any alterations, such as lighting the shadows, weakening the too accentuated wrinkles, vivifying the visual spot, etc., just as well as on the negatives.

There are two methods of retouching: Filling white spots and removing the black stains. The filling is done as previously stated, and the plate fired again. Stains are removed with hydrofluoric acid applied with the point of a wooden stick or of a needle. As soon as the stains are

* A very useful brush employed in glass and porcelain paintings. It is also called "dabber" (in French, *putois*). There are two kinds, one with the hairs cut off to terminate in a flat surface, the other with the same cut off at an angle and used to dab or stipple on curved surfaces, vases, cups, etc. Some of various sizes should be at hand.

Another useful dabber is a cushion made of a thin piece of chamois, tied to a very small tuft of cottonwool. A leather stump is also employed for dabbing on very narrow spaces.

touched by the acid, the latter should be wiped out with a damp rag.

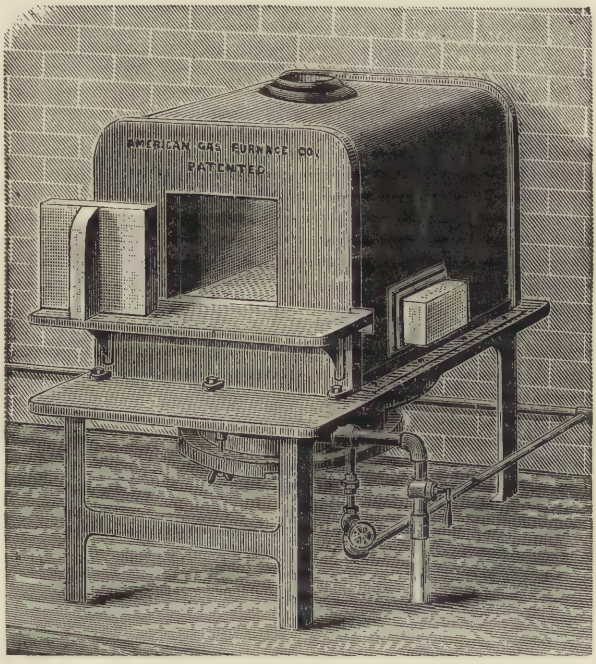
The lights can also be cleared by dilute hydrofluoric acid and water 1 in 10. It is a delicate operation.

Vitrification. (Firing.)

For firing glass, porcelain, pottery, etc., on a very large scale, kilns set in a work of fire-bricks should be built. The manner of conducting the vitrification of the enamel-colors then differs in some respects from that described in the following. For this purpose, treatises on ceramics, glass staining, etc., should be studied.

To vitrify the images on enameled copper-plates or on porcelain, delfware, and glass plates, or on small cups, vases, etc.; the portable enameler's furnace of clay, iron bound, answers well. But by far the most convenient are the muffle furnaces heated by gas manufactured by the "American Gas Furnace Co." They are ready for use in a moment, there is no necessity of watching and keeping up the fire, since the muffle being heated by gas burners under control, the temperature can be regulated so as to steadily maintain it at any degree. These furnaces can be had with square or oblong muffles, which are preferable for our purposes to the arched muffle, conveniently allowing the

firing of small potteries; moreover, the object being equally distant from the walls of the muffle is more uniformly heated. These and the ordinary clay furnaces are made of different sizes. The latter are always arched. One with



a muffle 10 x 6 x 4 in. may be purchased for about twenty-five dollars. The gas furnace No. 17 corresponds to this size. The muffle is 9¾ x 5½ x 4½ inches high, and square. It costs about fifty dollars.*

* All these furnaces are similar to those employed for gold and silver assays.

The muffles in ordinary kilns are of two kinds, viz., the muffle closed under by a plate of fire clay and the open muffle which has no base. The latter is generally employed by enamelers, although presenting more danger of burning (over-heating) the picture, which thereby loses its intensity and brilliancy from the decomposition of the coloring compounds. However, by employing as supports thick and wide clay plates, the enamel can be sufficiently isolated from the fire.

To heat the common furnace of clay, the muffle and the lid are removed and a fire of coke broken in small pieces, or of charcoal, is built on the grate, then the muffle is inserted and upon it a similar fire is built, taking care to fill with combustibles all the spaces around the muffle. The layer of coke should be thicker upon the muffle, for it is the heat from above which principally effects the vitrification. The fire being built, the lid is put in its place and a stovepipe about one meter long is adapted to the chimney of the furnace to increase the draft.

The heat at which the vitrification takes place with the fluxes ordinarily employed to mix the metallic oxides is the moderate red cherry, and seldom exceeds the white rose with the less fusible mixtures.*

* The heat should not exceed the intense red in firing glass plates. At the red white heat they become deformed and pin-holed.

When the latter degree of heat is necessary, it will be pointed out in giving the formulas of the colors, otherwise the red cherry is the temperature at which the vitrification should be made.

When the proper temperature is reached and uniform above as well as under the muffle, and, if the clay furnace be employed, nothing but the slight bluish flame of the coke or charcoal is visible, the object to be burnt-in is introduced in the muffle. For that purpose a ring of fire-clay is placed in the muffle, and when it has reached the red cherry heat a disc or a plate of fire-clay, coated beforehand with a thin layer of a paste of chalk in water and dried, is taken hold of with an enameler's tongs and placed on the ring, where it is allowed to become hot. It is then taken out, laid on the table at the mouth of the muffle, and the object is placed upon it in the center, and if it is a glass or an enameled copper plate no part of it should project out, else it would be deformed by being softened in the muffle and the proof be spoiled. There, at the mouth of the muffle, which is kept open, the object should be gradually and uniformly heated by turning the support now and then in order that the object shall not crack by the sudden and great change of temperature when introduced in the muffle. Now, when it is very hot, it is inserted in the

muffle on its support, that is, the disc or plate of clay, and from this moment the operation should be watched very attentively by viewing the object at the door of the muffle, which must be kept open or partly so, for a few minutes suffice to melt the colored flux, and if it is allowed to remain for a certain period exposed to the action of the red cherry heat the image may when fusing lose its brilliancy or vigor.

When in the muffle the collodion first burns off (if the proof has been transferred image upward), the image seems to vanish, to re-appear soon, and afterward becomes brilliant in places, which indicates that the color commences to melt. The plate should then be turned around to equalize the temperature, the heat always being stronger at the mouth of the muffle than in the center and as soon as the picture becomes brilliant all over; as if it were wetted, the fusion is complete and the disc or plate of clay with the object upon it should be brought out with the tongs on to the table and close to the mouth of the muffle, and there turned around till cool below redness when it is placed on a very hot brick, upon which it is allowed to cool well sheltered from any draught of cold air which may cause the enamel to split or scale.

As seen, the vitrification is a simple operation

which presents no difficulty. The only points to bear in mind are:

1. To gradually heat the object to a high temperature before inserting it in the muffle.

2. Not to introduce the object in the muffle heated to a higher degree than the red cherry—about 700 deg. C.

3. To remove the object from the muffle as soon as the enamel color is in fusion. If on its removal the deep shadows of the picture are not quite brilliant, as if wetted, the fusion is not effected thoroughly and the object should be inserted again in the muffle, when in a few seconds the fusion will be completed.

4. Cooling the object, to take the same precautions as for heating before firing, that is, to proceed gradually.

Instead of heating the objects before firing, or cooling them afterward in the manner previously described, an oven made of sheet iron can be provided with one or two movable tablets, also of iron, upon which the objects are placed for the purpose in question. Much time will thus be saved, as all the objects can be heated at the same time, and as they have been fired, placed in the same, when they are allowed to cool gradually by simply extinguishing the heating apparatus, which may be a spirit lamp, Bunsen gas burner, etc.

5. Lastly, to avoid any draught of cold air in the operating room. The doors and windows should be closed and the room heated to a medium temperature on cold days.

When burnt-in the image is not always brilliant enough. A glaze should be applied. For that purpose, when the object is cold, a coating of a mixture of equal parts of thick lithographic varnish and turpentine oil is applied uniformly by dabbing, then a finely ground and very fusible flux is dusted over, and when dry the object is again fired. In the foregoing pages another method of glazing is given, to which the reader is referred.

Here we must remark that the images burnt-in on hard porcelain, where glazing is produced at the "grate fire," *i.e.*, between 1,000 and 1,200 deg. C., do not take the brilliancy obtained on delf, pottery or enameled copper plates where glazing is effected with a flux fusible at the "muffle fire," and therefore melts or softens at the cherry heat so that the color employed for the development unites with it, the whole producing a brilliant image. Therefore it is advisable when transferring on porcelain to glaze it beforehand with a flux fusible at the temperature in question. The flux *rocaille* answers this purpose well. Its composition is given in the next paragraph.

Porcelain and delf require greater care to fire them than enameled copper plates. They should be more gradually and strongly heated before being introduced in the muffle, in this case not heated to redness; and during the operation the door of the muffle should be closed until the proper temperature is reached, which is ascertained by partly opening the door.

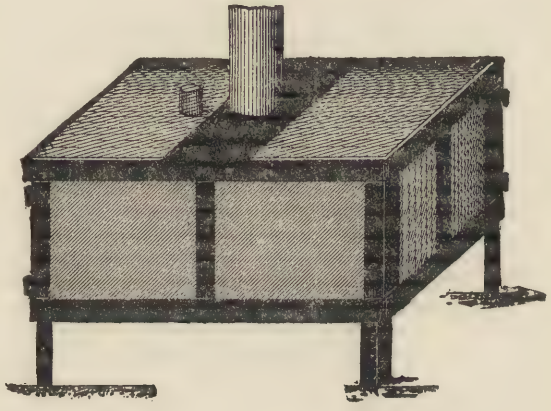


FIG. 1.—EXTERIOR VIEW.

Glass plates are fired in the same way as enameled copper plates and at the same temperature. In order to avoid deformation, they should be placed on a *plane* cast iron plate coated with chalk and one upon another separating them by a layer of plaster. The usual precautions before and after firing should, of course, be taken.

It has been said that the vitrification of the enamels employed in the dusting processes takes place at or about the red cherry heat. To correctly judge this color of the fire certain precau-

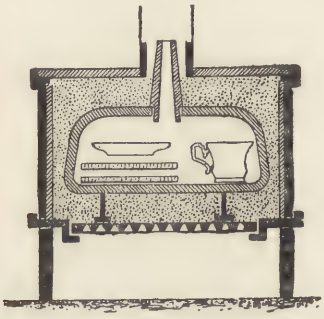


FIG. 2.—SECTION IN WIDTH.

tions should be taken, thus: in a well-lighted room the bright red heat seems dull, appearing more intense if the room be obscure—everybody

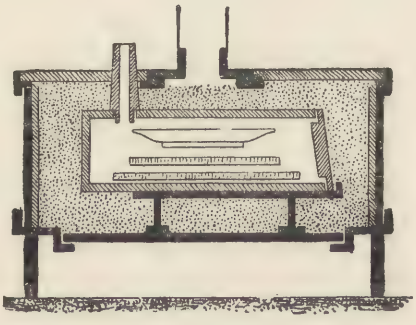


FIG. 3.—SECTION IN LENGTH.

has observed this—therefore we must as far as possible vitrify in the same conditions of light,

regulating the lighting of the room by means of curtains.

The Lacroix's Patent Portable Kiln, represented in the foregoing cuts, obviates the difficulty one may experience in firing. It is a simple apparatus in which the objects can be fired at home and without attention.* The outside dimensions are: Length, 19 inches; width, 13½ inches; height, 12 inches. The black parts of the cuts indicate iron; the lined parts, fire brick and the dotted parts in the sectional drawings the fuel. The kiln is provided with flat muffles, one 11¾x9¾x3½ inches, another 10¼x8½x2½ inches, and one oval 8¾x6¾x4½ inches.

For use, the following directions are given: After placing the articles to be fired in the muffle, which should rest on the iron supports as shown in the cuts, close the muffle and fill up the surrounding space with small charcoal; take care that the muffle is put in such a position that its chimney will fit into the round aperture of the fire-brick cover. Cover up the kiln and ignite the charcoal from below through the grate, with burning paper or wood. In about one hour the fuel will be consumed, and after the kiln has cooled off remove the ashes, take out the articles

*The kiln costs $16. It can be had from J. Marsching & Co., New York, Agents for Lacroix's enamel colors.

and the firing will be completed. The heat obtained is that of the ordinary muffle heat of china decorators.

Enamels, Fluxes, Colors for Dusting.

The enamels are the colored vitrifiable substances which adhere to glass, porcelain or to a less fusible enamel by the action of a temperature sufficient to melt them. When applied to glass plates the enamel should, of course, be more fusible than the compound of the glass itself, in order to be fixed before the glass plates reach the temperature at which it would be deformed by a commencement of fusion.

The enamels are compounds of coloring substances, generally metallic oxides, and of fluxes or vehicles of the colors. With the exception of the oxides of cobalt, antimony and copper which impart their characteristic color, blue, yellow and green, only when fused with a flux, all the other oxides are simply mixed with the vehicle.

The fluxes or vitrifiable compounds are more or less fusible; those employed for enameling copper or glass plates should necessarily be less fusible than those used to compound the colors. Here is the formula of an opaque white enamel for glass plates fusible at a comparatively low

temperature, together with that of the black powder for developing on the same:

WHITE ENAMEL.

Arsenic	1 part
Saltpetre	1 part
Silica	3 parts
Litharge	6 parts

BLACK COLOR FOR DUSTING.

Oxide of cobalt	2 parts
Black oxide of iron	10 parts
Minium	20 parts
Silica	6 parts

The enameling of copper-plate is a tedious operation, which the extent of these papers does not allow of a description. They are manufactured for our purpose and can be had of any size desired.

FLUXES.

1. *Rocaille.*

Silica (silex three times calcined, powdered and washed)	1 part
Oxide of lead	3 parts
Borax, calcined	1 part

It is prepared by mixing the ingredients, fusing rapidly, and then spreading the matter in fusion on a metallic plate and pulverizing, when cold, into a very fine powder.

For use, one part of metallic oxide is mixed with three parts of flux. The color is employed for staining glass and for painting on porcelain and enameled copper-plates.

2. *Fluxes for Purples.*

a. Silica.....3 parts
Minium.....1 part
Borax, calcined.....7 parts

This flux is pretty fusible and quite inalterable. By compounding it with two parts of silica instead of three the flux is more fusible. and its fusibility still increases by diminishing the proportion, but the flux is then easily attacked by dampness and liable to scale.

For porcelain, the following less fusible compound is generally employed:

b. Silica.....4 parts
Minium.....3 parts
Borax.....6 parts

Both fluxes are prepared as No. 1 (*Rocaille*).

3

Silica.....2 parts
Oxide of lead .....6 parts
Borax, calcined.....1 part

This flux is the most generally employed in porcelain painting, being mixed with the gray, black, red, blue and yellow coloring matters in the proportion of 1 of the various oxides to 3 of the flux.

4. *For General Use.*

Flint glass.....3 parts
Minium.....1 part

5.

Flint.....1 part
Minium.....4 parts
Borax, calcined.....4 parts

NON-COLORED ENAMEL FOR GLAZING.

Silica	50 parts
Minium	100 parts
Borax, calcined	200 parts

This enamel also serves as a flux and can be colored by various oxides ; thus : For violet, mix with the above quantity, 12 parts of carbonate of manganese. For yellow, 2 parts of potassium chromate. For gray, 2 parts oxide of cobalt and one part each of oxide of copper, manganese, and red oxide of iron. For blue, 6 parts of oxide of cobalt. For green, 10 parts of oxide of copper. For brown yellow, 40 parts red oxide of iron.

All these are prepared by fusion, then pouring the melted product on a metallic plate and powdering it when cold. They should be applied in thin coating, else they split.

DUSTING COLORS.

The colors for dusting must be reduced into impalpable powders to adhere to the photogenes and develop the image—as it is termed—in perfect gradation, reproducing the faintest details just as a silver print. In fact, they never are too fine. When bought from the dealer, although generally triturated, they should again be ground on a ground glass with a little water, and this repeated, after drying in an

oven, to insure a perfect desiccation; for use they are passed through the finest sieve that can be procured. It should be noted that the image will be flat and gray after firing if the powder, rubbed upon a white paper, does not blacken it.

For enameled copper-plates and porcelain M. de Lucy-Fossarieu recommends the following dusting compounds:

Porcelain black, hard	50 parts
Purple brown, hard	25 parts

Mix, grind, etc. The object is fired at white rosy heat, about 800 deg. C.

One obtains with this mixture a very dark brown the tint varying according to the intensity of the heat to violet, black or blue. The tint can be modified by adding more black or more brown.

BLACK COLOR.

Iron oxide	2 parts
Copper oxide	2 parts
Manganese oxide	1 part
Flux No. 1 (*Rocaille*)	10 parts
Borax, calcined	1 part

Mix and melt in a crucible, then pour the mass slowly in water, pulverize and mix with

Maganese oxide	1 part
Copper oxide	2 parts

grind the whole, etc.

This black is very opaque if only five parts of flux and half a part of borax are incorporated. It is not likely to scale owing to the oxides added to the mixture.

ANOTHER.

Copper oxide	2	parts
Cobalt oxide	3	parts
Iridium oxide	0.1	part
Sienna	1	part
Flux (*Rocaille*)	15	parts
Borax calcined	1½	parts

This forms a very fine black which resists the action of sulphuric acid employed to destroy the collodion when the image is transferred face downward.

BROWN COLORS.

Dissolve separately.

a. Ferrous sulphate	2	parts
Water, warm	10	parts
b. Potassium bichromate	2	parts
Water, warm	10	parts

Mix. Let settle till clear—wash on a filter—desiccate the precipitate (iron chromate) in the oven and keep for use.

The color consists of.

Iron chromate	1	part
Flux (*Rocaille*)	3	parts

Grind the whole on a ground glass with a little water, dry thoroughly and keep for use. This enamel is opaque.

ANOTHER, DARKER SHADE.

Calcined Umber..... .....1 part
Flux (*Rocaille*).... .....3 parts

The components should not be fused, but simply mixed as stated above.

These brown powders are employed when the images are to be transferred to blue, black, etc., enameled plates. Some operators employ them when the pictures are to be colored after firing.

LAMP BLACK.

Manganese oxide..... 2 parts
Colbalt oxide.....$\frac{1}{10}$ part
Borax fused..... 1 part
Flux No. 4..... 3 parts

If the pictures are to be colored the most favorable dusting powder is a neutral tint obtained by grinding together with a little water, the red, yellow and blue dry enamel colors in certain proportions. The neutral tint is indispensable to form the shadows, much facilitates the work of the colorist, and does not alter the purity of the colors afterward applied upon it. The iron chromate dusting color is also excellent. The tone after firing is a rosy yellow brown.

COLORS FOR PAINTING ON GLASS.

The colors for painting should be ground as fine as those employed in water color, that is,

when brushed on they should leave a tint quite devoid of granulation, such as that obtained by a wash of India ink, for example.

The following are the colors used in glass painting. They are transparent:

DARK RED.

Sulphate of iron, calcined.....1 part
Flux No. 3.....3 parts

RED FOR FLESH.

Red oxide of iron.....1 part
Flux No. 3.....3 parts

For fair complexions a small quantity of silver chloride is united to the flux.

RED PURPLE.

Purple of cassius, especially prepared*.. 1 part
Flux No. 2 A..... .....100 to 160 parts

One tenth gives a deep shade.

CARMINE.

This color is prepared by adding to the above a small quantity of silver chloride fused beforehand with ten times its weight of flux.

---

*To prepare the purple of cassius, we advise the following process: Dissolve 20 grains of pure gold in 100 grams of aqua regia consisting of 4 parts of hydrochloric acid and 1 (one) part of nitric acid. After evaporating to dryness, the residue (auric chloride) is dissolved in a quantity of distilled water to make up 750 cubic centimeters, then a few plates of pure tin are placed in the liquid which soon assumes a brown coloration and deposits a precipitate of a fine purple color. When the liquid remains brown, one adds a concentrated solution of sodium chloride which produces a new precipitate. The compound thus obtained corresponds to this formula: $AuO.SnO_2$, $SnO.SnO_2$.

BLUE.

Oxide of cobalt	1 part
Flux No. 3	6 to 9 parts

Three parts of zincate of cobalt may be mixed instead of the oxide. The zincate is obtained by precipitating a solution of 1 part of sulphate of cobalt in 2 parts of sulphate of zinc, by carbonate of sodium and washing, then desiccating the precipitate.

LIGHT YELLOW.

Chloride of silver	1 part
Flux *rocaille*	5 parts

YELLOW OCHRE.

Zincate of iron	1 part
Flux No. 3	4 parts

Mix. By heating the mixture to dull red heat the transparency of the burnt-in color is improved.

The iron zincate is prepared by precipitating a solution of persulphate of iron and of sulphate of zinc by carbonate of sodium. The precipitate should be well washed and dried for use.

ORANGE YELLOW.

Sulphite of silver	1 part
Flux *rocaille*	5 parts

LIGHT GREEN.

Silica	4 parts
Minium	12 parts
Oxide of copper	1 part
Red oxide of iron	⅛ part

Pulverize together and fuse.

INTENSE GREEN.

Silica	1 part
Minium	4 to 7 parts
Oxide of copper	1 part

Prepared as above.

VIOLET.

Silica	1 part
Minium	6 to 8 parts
Peroxide of manganese	0.5 part

Prepared as above.

ANOTHER.

Violet oxide of iron	1 part
Flux No. 3	3 parts

BROWN.

Precipitate a solution of 10 parts of persulphate of iron and 2 parts of sulphate of zinc by carbonate of potassa, wash and dry the precipitate then mix in the proportion of 1 part to 4 of flux No. 3.

The zincate of iron prepared as for yellow ochre and mixed with calcined sienna gives a red brown, the tint varying with the proportion of the components.

The same zincate with calcined umber forms a dark brown not inclining so much to the red.

Calcined umber, alone, also gives a brown enamel.

The peroxide of iron prepared by precipitation, then calcined at red heat yields a brown of a tint varying more or less strongly by heating.

All these compounds are prepared by simply mixing with flux No 4.

BLACK.

Black oxide of iron or calcined trioxide.....	1 part
Flux *rocaille*.....	2 to 3 parts

This color is black by transparency and browish by reflected light. It is employed for "grisailles."

WHITE.

Silica.....	30 parts
Calcine.....	75 parts
Borax calcined.....	20 parts

Mix, fuse, etc.

To prepare the *calcine* for this flux mix 80 parts of lead with 20 parts of tin, calcine in an iron crucible at dull red-cherry heat and scrape off the lead tannate as it forms, taking care to obtain it free from undecomposed metal, then reduce to a fine powder.

Another white enamel formula has been given in the preceding pages.

COLORS FOR PAINTING ON ENAMELED PLATES, PORCELAIN AND DELF.

The red, flesh, purple, carmine, blue and other colors employed in glass painting answer equally well for painting on enameled plates, porcelain and delf. We complete the list by giving a few more formulas. All these colors are vitrifiable at the muffle heat.

DARK BLUE.

Carbonate of cobalt .....13 parts
Carbonate of zinc, hydrated.....23 parts
Flux No. 3.....61 parts

Prepared by fusion.

BLUE AZURE.

Carbonate of cobalt..... 7 parts
Carbonate of zinc, hydrated..... 4 parts
Flux No. 3.....70 parts

Prepared by fusion.

BLUE GREEN.

Oxide of chromium.....1 part
Oxide of cobalt.....2 parts
Flux No. 3.....8 parts

LIGHT YELLOW.

Subsulphate of iron..... 1 part
Oxide of zinc..... .....2.5 parts
Flux No. 3.....10 parts

ORANGE.

Subsulphate of iron..... 1 part
Antimonic acid.....1.5 parts
Flux No. 3..... 8 parts

DARK GREEN.

Oxide of chromium.....1 part
Flux *rocaille*..... .....3 parts

EMERALD GREEN.

Oxide of copper... ..... 1 part
Antimonic acid.....10 parts
Flux *rocaille*.....30 parts

VIOLET.

Oxide of cobalt..... 1 part
Binoxide of maganese..... 3 parts
Borax, calcined..... 3 parts
Flux No. 5.....24 parts

GRAY.

Binoxide or manganese..... 20 parts
Oxide of cobalt..... 1 part
Borax, calcined.....10 parts
Flux No. 5.....30 parts

DARK GRAY.

Carbonate of cobalt..... 4 parts
Peroxide of iron hydrated (yellow oxide)..... 2 parts
Flux No. 3..... 88 parts

Prepared by fusion.

BROWN FOR THE HAIRS.

Persulphate of iron..... 1 part
Oxide of cobalt..... 1 part
Oxide of zinc..... 8 parts
Flux No. 3.....30 parts

GOLD (GILDING).

FLUX.

Oxide of bismuth..... 1 part
Borax, fused.....$\frac{1}{12}$ part

ENAMEL.

Gold, pure in powder..... 1 part
Flux .....$\frac{1}{12}$ part

The professional and amateur seldom prepare their own material. We recommend the excellent colors prepared by Lacroix, of Paris. They are sold in tubes ready for use, or in finely ground dry powder put up in bottles.

It is remarked by some authors that it is best to use French or English colors on French or English porcelain, and German colors on German porcelain, as the flux employed in the mixing of colors is adapted to the glaze of the porcelain in each of these countries. This is a good piece of advice.

As to the porcelain to be used, the writer recommends the plates, vases and cups made at Limoges by Haviland & Co. Nothing is finer.

Coloring.

The coloring of the burnt-in pictures does not present difficulties that an aquarellist or an oil painter of ordinary ability cannot master with a little practice. One does not need to be a good designer to produce artistic effects: the image is already there, with its gradations of lights and shades. As to the plain coloring or tinting similar to that done on silver prints on plain or albumen paper, any one can attempt it and obtain tolerably good results at the first attempt by using transparent colors applied in glazing in order not to destroy the resemblance by covering the design.

There are two general rules to be borne in mind when painting in vitrifiable colors:

First, to smooth the tints and even to apply the colors by dabbing, except, of course, on small spaces, and then upon the flat coatings to model also by dabbing, or by stippling, if the latter method is thought best.

Second, not to attempt to finish the coloring at once, but to proceed by successive applications and firing after each one, thus; in coloring a portrait, for example, the ground is first tinted, then on the face and hands a general yellowish flesh color is applied, the half tones touched up with a warm tint; and before the color is dry, the deep shadows are strengthened with a

darker shade of the same color and the whole blended with the dabber, then the lips are reddened, the eyes, eyebrows and hair tinted, and the draperies worked up, all the colors being applied in more or less, but always thin coatings. This done, and after vitrification the the whole is repainted, modeling the face with proper tints, accentuating the shadows, darkening the folds of the draperies, and so forth, and again fixing, when by once more working the picture over, using glazings of red in the face to impart freshness to it, applying light tints to brighten the half shadows, the picture preserves its clear and brilliant appearance, and stands well modeled in relief.* For the first and second paintings transparent colors should be used and the opaques reserved for the last touches to give vigor to the whole. Of course there are certain dodges employed in modeling without resorting to vitrification after each application of the tint, for the picture cannot well stand, when upon glass, more than three firings without danger of being spoiled, and, on the whole, the less firing necessary the better it is. These dodges will be explained.

It has been said above that the background

* Fine artistic pictures require four or five firings. and, therefore, to be worked up as many times. Flowers can be finished in two operations.

should be first tinted, but is as well and even preferable to finish it after the last firing in order to place the contrasts where they are the most useful.

The brushes employed in porcelain and glass painting are sable ones, the hard and soft brushes used in oil painting, and the stipplers (dabbers) which are the most useful of all; they should be had of various sizes. The French brushes are by far the best.*

To apply the colors when the space is narrow a sable brush is selected; if it is large, a flat brush is employed. Then the color is spread one way, then another, until the coating is even, when the brush marks are removed by dabbing as soon as the color commences to dry, for it is then only that a perfect and even coating can be obtained.

The hard brushes serve for the "brushing out" process.

We repeat—for this cannot be too much insisted upon—that the colors should be used in a state of extreme tenuity. After passing through a porcelain mill, especially made for that purpose, they are ground with distilled water, dried, and for use a small quantity—10

* Most of the brushes employed in glass and porcelain painting are expensive and, therefore, good care should be taken of them. After the work of the day is done they should be cleansed with turpentine, then rubbed with water on a cake of soap and finally rinsed.

or 15 centigrams—mixed with a viscous vehicle, in order that, when applied, the color does not run or spread on the picture and remains sufficiently adherent after drying.

The viscous vehicles are a mixture of borax and sugar candy dissolved in water, and the fatty oils of turpentine or of lavender thinned with the same ordinary oils. All these vehicles have their utility ; sometimes before firing they are employed alternatively—especially in glass painting—to superpose colors one upon another, or a darker shade on another of the same color to obtain gradation in modeling.

As naturally expected the water colors are more fluid and less supple than those mixed with oils and consequently not so easily applied. Hence when the color is required to be laid on a large space, the latter must be employed, selecting the vehicle made with the fatty and ordinary oils of turpentine, when it is necessary that the color dries rapidly—which is advantageous when dabbing an even coating and the lavender oil mixture for blending different shades of the same color.

The oil colors are prepared by mixing the color to a sufficient quantity of the fatty oil to form a thick paste and thinning this with a certain quantity of the ordinary oil according to the shade desired. To obtain a homogene-

ous mixture the paste should be worked upon a ground glass with a glass pestle; a horn palette knife only should be used to take it up.

The water colors are prepared in the same manner substituting a syrupy solution of sugar-candy for the fatty oils. From 30 to 50 centigrams of sugar for 4 grams of color is the proportion recommended. The latter proportion is used when required to draw with the pen. By mixing 60 centigrams the color is liable to scale in drying or before melting in the muffle.

It is important to mix the colors as little as possible for at the temperature of the furnace the metallic oxides tend to form new compounds and, therefore, the tint expected may be altered. When certain colors are desirable it is best to cover one color with another; thus: to produce the color which resulting from a mixture of yellow ochre and red, one first applies the yellow and glazes with red after firing, and to obtain violet, one applies the blue mixed with sugar water, allows it to dry, and covers it with a coating of purple mixed with oils. Green and blue should similarly be applied on red and carmine, but blue can be mixed to green, brown to black, etc.

It is also important to apply the color in thin coatings, else they are liable to crack or scale by

the difference in their expansion to that of the material upon which they are applied.

Painting on glass presents certain difficulties, on account of its smooth surface. When one attempts to apply a flat, even tint, the second stroke of the brush often effaces the color already laid down. This also occurs in porcelain painting; but the difficulty is overcome by dabbing and, when not objectionable, by applying a thin coating of pure oil of turpentine, which when dry permits the spreading of color, or by giving a tooth to the surface by grinding it slightly with emery. The greatest difficulty arises, however, from the nature of the vehicle which does not admit of superposing one upon another—even after desiccation—several colors prepared with the same adhesive substance, the reason is self-evident. But the difficulty can be overcome by changing the nature of the vehicle for each color employed, for example; one applies an oil color on another prepared with sugar-water, which is, therefore, insoluble in the vehicle of the former. However, it is possible in operating, as it will be presently pointed out, to apply several tints of water colors one on the other. To commence with, one mixes the colors with as little sugar as it is possible to secure adherence, then, in applying the other colors, they are mixed with more and

more sugar, whereby the increasing density of the vehicle prevents it dissolving the color previously applied. This method is that generally employed by artists.

There are many other *tours de mains.* The limitations of this little work do not admit us to describe them *in toto.* However, to complete these instructions so that they be really useful we will describe a simple process daily employed by artists when painting on glass in the gothic style; we refer to the "brushing out" method. To model the face, for example, by the method in question one applies a general tint, with a color prepared with the oils of turpentine, which will form the lights, and upon this a coating of color prepared with water and thick enough to form the deep shadows. This being dry, by rubbing off with a hard brush one removes more or less the water color as much as necessary to obtain half shades or lights, with the color underneath, or the glass made bare by brushing off the entire superficial water color, forming the high lights, the half tints resulting from the incomplete brushing off of the same, while the shadows are formed by the whole thickness of the coating. It is thus that the artists work up the whole subject. When the parts to be brushed off form a sharp and well-defined design, embroideries for instance,

instead of a brush, one employs needles or wooden scrapers of various sizes and forms.

The colors for brushing off are prepared with borax and mixed with a quantity of water sufficient to make a thick paste, which is spread with a flat brush and smoothed by dabbing. A little borax suffices to cause adherence and allow the color to sufficiently resist the action of a hard brush.*

Coloring Before Firing.

By operating, as will be presently explained, the image on glass plate, delf, etc., can be colored, or, at least, worked up to a great extent without it being previously burnt-in. The plate is prepared, exposed under a reversed (stripped) diapositive, and after development the image is transferred in the ordinary manner. This done, and when the picture is dry, the plate is treated with concentrated sulphuric acid for one or two minutes to destroy the collodion, then washed, and after neutralizing the last traces of acid with a diluted solution of aqueous ammonia, 2 : 100, finally flowed several times with the following dextrine solution, and allowed to dry spontaneously, standing on one corner.

* Some artists advise the addition of a little sugar-candy.

Dextrine ..... 25 grams
Boiling water..... 1000 c.c. m.

Filtered through flannel when cold.

After drying, the picture is ready for the artist, who can work upon the plate with perfect security by employing colors prepared with essences of lavender or turpentine.

Printing on Delfware, Porcelain, etc.

(*Lithoceramic.*)

The ceramic processes described in the foregoing pages, although very good for the artistic decoration of porcelain, are too slow and therefore too expensive for articles of commerce upon which the same designs are reproduced thousands of times. In manufactories the image is made by transfer to the biscuit or to the glazed object, the only difference in the two methods consisting in this, that the biscuit being absorbent requires no previous preparation, while the glazed articles should be coated with slightly alumed water or with turpentine mixed with about one-twelfth part of copal varnish.

The proofs for transfer, or "printing," as it is termed, are pulled from copper-plate engraved in *intaglio* or from typographic blocks, which

can be made by photo-mechanical means; and it is here that photography intervenes in industrial ceramics to obtain more perfect work at less expense.

The plates engraved in intaglio are mostly employed, because the vitrifiable ink retained in the cuts is in sufficient quantities to make the finest lines quite visible; and as the thickness of the layer of ink is necessarily proportionate to the depth of the cuts, it results that the design is reproduced in better gradations of tints than that obtained from proofs printed with typographic blocks. However, the latter are preferred for delf, and potteries commonly decorated, on account of the cheapness and rapidity with which the proofs can be printed.

Two methods are employed to pull the transfer from intaglio plates.

First.—The plate is inked with a thick mixture of the vitrifiable color, mixed with strong lithographic varnish (mordant) thinned with a little turpentine oil, to which is added, except for the black, green and red colors, a certain quantity (about one-third) of lamp black, and the proofs pulled on moist unsized paper, very thin for transferring on the glaze, stronger and more tenacious for the transfer on biscuit.* The proofs are transferred when damp. If the

* A special tissue paper is manufactured for this purpose.

ink is allowed to dry the article should be coated with

White wax	15 parts
Venice turpentine	50 parts
Turpentine oil	1000 parts

and the transfer made as usual when the turpentine oil is evaporated.

Second.—The engraved plate is inked with the mordant, tinted with a little vegetable color, and the proofs pulled directly on a thin sheet of paper or of gelatine, or transferred on the latter. After transferring the dry vitrifiable colors are dusted on.

The former process is the most rational and also the most expeditious.

By printing the transfers on gelatine instead of paper, proofs of various sizes can be obtained from the same engraved plate by simply placing the gelatine sheet in contact with water or alcohol. In the first case the gelatine and the proof upon it expands, while in the other it contracts, the enlargement and diminution being pretty regular.

When printing on biscuit, the articles should be fired to destroy the fatty matters, before applying the glaze.

The methods of engraving in *intaglio* or in *relievo* have been described in *extenso* in "The Origin and Progress of Photo-engraving," published some time ago in THE PHOTOGRAPHIC

Times. Consequently we need only point out here the processes which will give the best results for the purposes in question.

Copper, or, better, brass plates which wear out less rapidly under the rolling of the vitrifiable colors, should be employed. After cleaning, to remove the oxide and greasy substances, the plate is slightly ground with pumice stone powder to give a "tooth" to the surface, and afterwards coated by means of the turning table with a solution of five or six parts of bitumen of Judea in one hundred parts of rectified turpentine oil, then, the coating being dry, the following sensitive mixture is applied :

Albumen	100 c.c. m.
Water	10 c.c. m.
Aqueous ammonia	5 c.c. m.
Ammonium bichromate	3 grams

The plate for intaglios is exposed under an intense diapositive. A few seconds in the sun, five or six minutes in the shade in fine weather, suffice to render insoluble the albumen in the parts which should form the reserve. After exposure the non-acted-on albumen is dissolved in cold water, then the bitumen left bare is washed out with turpentine oil, the plate rinsed under a strong jet of water, dried, and then heated over an alcohol lamp at a temperature not exceeding 40 deg. C. This done the plate, when cold, is etched with a solution of ferric

chloride at 45 deg. Baumé, for, say, twenty minutes, when it is rinsed by lightly brushing, gummed, inked, dusted with rosin, then gently heated to incorporate the rosin with the ink, and finally bitten-in so long as there is no danger that the lateral etching action of the ferric chloride, which is feeble, widens the cuts. Of course the plate should be examined from time to time and the fine lines (cuts) stopped out as usual when sufficiently deepened. When the depth attainable is reached, the plate is cleaned in a solution of warm potassa and finished by the engraver.

The typographic blocks should be etched quite deep. A depth of about two millimetres between the open lines is not exaggerated. It can be obtained by four or five bitings-in, each of half an hour duration, by etching with the ferric chloride solution at 45 deg. Baumé, acidified with two parts of hydrochloric acid per cent. As said above this mordant etches almost perpendicularly, the lines needing, therefore, little protection. The copper or brass plate is exposed to etch in relievo under a negative, and developed as for an *intaglio*, then etched to render the metal lithographic, that is, capable of retaining moisture by forming a granulation between the lines. For that purpose the plate is flowed after development with the following

liquid, which should be allowed to act for a minute :

Silver nitrate	5 grams
Nitric acid	10 c.c. m.
Alcohol	60 c.c. m.
Water	90 c.c. m.

Then the plate is rinsed, dried, gummed and inked with a hard roller charged with a stiff ink prepared by mixing transfer and printing inks in equal parts. After inking, the plate is dusted by brushing with rosin, heated, face downward, to incorporate the rosin to the ink, then, after cooling, gummed, inked, dusted and heated as before, then again heated while the ink is sticky, in order to form a good resist by these successive operations.

This done, the back, edges and the margin are varnished and when the test lines are scratched on the margin, the plate is ready for etching and needs no further preparation. The plate during the operation should necessarily be removed from the etching fluid and washed by brushing from time to time, say, every half an hour, to examine the progress of the biting-in, and when there is any sign of lateral action it is heated, in order that the ink runs down the side of the lines to protect them from the dissolving action of the mordant.

The typographic blocks are generally employed in printing by the dusting method.

Hints, Methods and Processes.

When the photogenes are made up with a bichromate and, therefore, necessitate the use of diapositives to print from, the original designs can be used direct—but they should be drawn on transparent or tracing paper with an opaque ink in the same way as those made for duplicating by the cyanotype or Pellet's blue process.

This possibility of employing as *clichés* drawings, engravings, lithographs, carbon prints, etc., rendered transparent is indeed a great help to the artist and saves time and expense, that great desideratum in all industrial arts. For example, let us suppose we have a design to reproduce on a church window. First, to obtain a non-reversed image, we place the design face downward in the printing frame, or, if the design is too large, we cut it in parts by following the marks indicating the leaden framework, or separating in a similar manner the subject from the borders or ornaments, then place the parts in as many printing frames as it is necessary. Now, the prepared glass plates are laid upon the design, taking care, when they are of different colors, that each one occupies exactly the place where it should be in the leaden framework, which is always indicated in

the design.* This done the frame (or frames) is placed in the shade—not in the sun—for the impression is always more perfect. However, if the designs were drawn on thick, not very transparent paper, one may expose to sunshine, thereby diminishing the exposure more than one-third. It is important when the design is cut in pieces to expose all of them at once, and during the same period to obtain similar impressions. After exposure the plates should be kept in the oven, and as many as it is convenient to develop together being placed side by side, one proceeds as usual.

Stamped paper with perforated designs, such as placed in boxes of candies, embroideries, etc., can be employed for the decoration of potteries, stained glasses, etc., or as borders for framing, by cutting and fitting together certain parts and using them either as *clichés*, or to make diapositives by contact according to whether they are to be reproduced as white on a colored ground or *vice versa*. They may also be reduced or enlarged by the camera to suit the size of the objects upon which they are to be applied.

*In glass painting, plates of the various general tints of which the design is composed are cut in the shapes indicated by the design, and upon them the design is traced and colored; thus: white or yellow stained glass plates are cut in the shape of the face, others stained with the proper tints cut in the shapes required for the draperies, etc., and upon the whole the design is drawn, shaded, etc.

Cameo glasses may be decorated with these articles; the embroidered curtains, laces or tulles, etc., are spread on the glass plates of the printing frame and upon them are placed the window glasses prepared with a photogene which may consist of 8 cubic centimeters of liquid glucose, 6 c. c. of a saturated solution of ammonium bichromate and 100 c. c. of water. The exposure is very short, since the light acts directly through the open spaces of the design. As to the development it is effected as usual by dusting on a white enamel.

The cameo glasses are also maufactured by enameling the whole plate, then applying a reserve which forms the design, and, this done, etching with hydrofluoric acid.

There is an instrument forming an infinite variety of images of the most beautiful colors, chiefly used as a toy, but also in the decorative arts to suggest ideas of symmetrical design, which to the knowledge of the writer is not employed in ceramics and glass staining. We refer to the kaleidoscope, invented by J. B. Porta. An instrument similar to it, called the Debuscope, from the name of the inventor, is employed for forming patterns in calico printing. Another is made in which the angle of incidence of the mirror can be varied, and, by means of a system of lenses, the design being

lighted by a lamp, can be projected on a screen in the same way as the images of the slides placed in the magic lantern, and then drawn or photographed. For our purposes the ordinary large kaleidoscope could be made so as to be adapted at will in front of the lens of the camera obscura in order to photograph directly the symmetrical combination of images formed by each turn of the instrument. The tube should consequently be made in two sections, one sliding into the other to admit enlargement of the image, and the pieces of glass, beads, feathers, etc., colored with more or less but not very non-actinic colors so as to be easily photographed by the orthochromatic process.

Designs on glass plates to be framed face downward or employed in a like manner for the decoration of cabinets, boxes, etc., are manufactured abroad on a large scale by the dusting on or transfer process. Generally they are not made in vitrifiable colors and therefore not fired, although much finer articles can be produced in this manner; thus: a *bas relief*, such as, for instance, the evening or the morning of Thorwalsden, photographed by a light falling obliquely at a very small angle upon it, in order that the contrast of lights and shades shall produce the illusion of relief. This is then printed in *grisaille*, fired, then bordered

with a Greek or other ornament by a second operation, that is, by preparing the plate anew, and exposing under the *cliché* exactly registered, This forms a picture not devoid of artistic effect. A white or colored enamel should necessarily form the ground, or the design only may be backed and the ground silvered, gilded or bronzed.

When the picture is not to be burnt-in, the image is developed with Cassel-earth, umber, ochres, or any color in fine powder, then fixed with alcohol acidified with 25 or 30 parts of nitric acid per cent., then colored with oil colors in tubes thinned with burnt and drying oils, and when the colors are dry, the ground may be washed out with a damp sponge to replace it with another. As to the gilding or silvering, it is done by applying gold and silver leaves with the gilder's size. Bronze powders can also be fixed on this size by dusting.

To fix the glass-plates on a table decorated by one of these processes, spread on the wood with the palette knife an even and thick coating of white lead paint, and upon it lay the plates, applying pressure to cause adherence everywhere, then secure the whole with a copper wire, which also serves as a border, and in a few days, when the paint is dry, the plate and the table form a solid whole.

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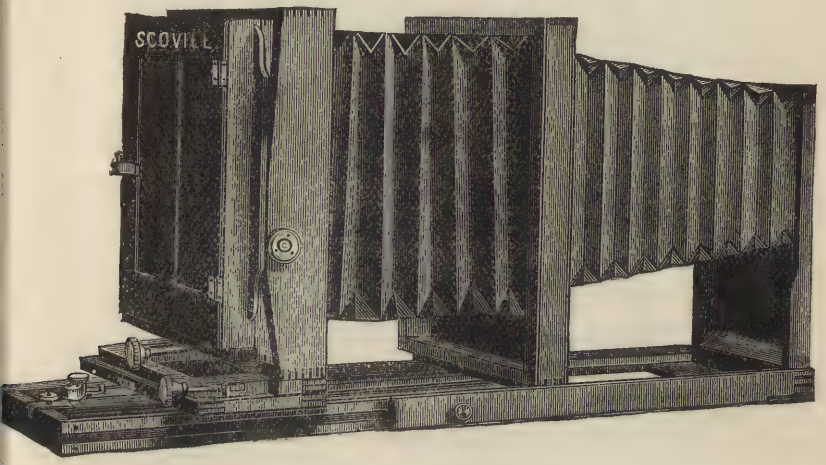

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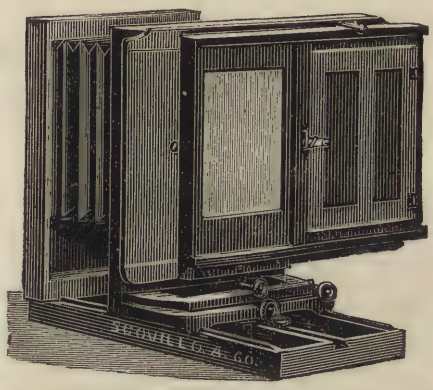

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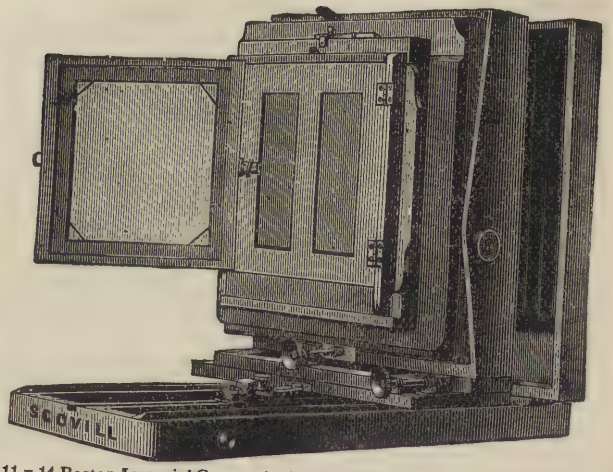

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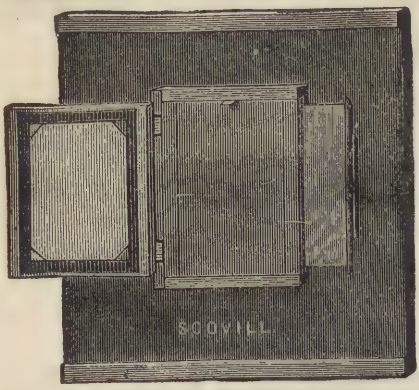

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"	15 x 18	"	"	"	"	"	"	"	" 12 00
"	17 x 20	"	"	"	"	"	"	"	" 13 00
"	18 x 22	"	"	"	"	"	"	"	" 13 00
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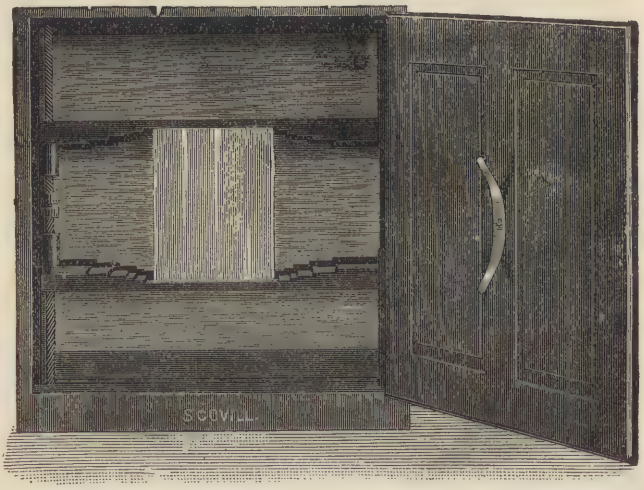

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